CE 417 Pavement Materials and Design **Name:** _____

FALL 2000 Midterm Exam **Student Id:** _____

Read all questions carefully and thoroughly. This is a closed book exam. Show all calculations, label all diagrams completely, and answer all questions concisely for full credit. Neatness counts!!!!! Calculators allowed. 1.5 hours to complete the exam.

1) What are two aging mechanisms of asphalt concrete in the field and what two primary factors significantly influence asphalt concrete aging in the field? (5 marks).

2) How does asphalt concrete aging potentially change the physio-chemical structure of asphalt concrete and what can be done to mitigate asphalt concrete aging in the field? (Be sure to describe the physio-chemical processes involved with asphalt concrete aging mechanisms). (5 marks)

3) What is meant by "aggregate interlock" and describe the influence that increasing aggregate interlock has on the mechanical behavior and therefore the field performance of hot mix asphalt concrete pavement? How does Superpave™ specifications ensure adequate aggregate interlock? (5 marks)

4) What process is used to enhance aggregate interlock in hot mix asphalt concrete production and what are the potential disadvantages associated with increased aggregate interlock? (5 marks)

5) Asphalt concrete is a thermoviscoelastoplastic rheological particulate composite material. You are performing uniaxial compressive creep-recovery tests in the lab. (10 marks)

   a) Using a plot of applied traction versus time superimposed onto strain response versus time, conceptually illustrate and compare the mechanical behavior of asphalt concrete displaying elastic and viscoelastoplastic behavior.

   b) What do these differences mean in terms of field performance of asphalt concrete pavement?

6) What are five field state variables (conditions) that influence the mechanical behavior (performance) of a asphalt concrete? (5 marks)

7) What are three classes of asphalt concrete mix plants, briefly describe their operational characteristics, and briefly describe the advantages and disadvantages of each. (5 marks)

8) Road engineering has predominantly been based on experience (empiricism) or phenomenological-empirical methods for design/analysis/specifications/QC/QA of road construction/preservation projects. These methods have served engineers moderately well in the past with traditional materials and field conditions. In this context, describe and compare the differences between phenomenological and mechanistic approaches (advantages and disadvantages) with respect to testing road materials. Discuss the reason for the road building industry's move towards a mechanistic based framework and the reasons why mechanics have not been readily used in road engineering in the past. (5 marks)

9) Conventional road geotechnical soil characterization has employed a handful of tests to characterize road soils for road design and analysis purposes. Name five conventional geotechnical tests and describe how they are used to characterize and specify road soils for design, construction QC/QA and field performance predictions. Give some reasonable test values for clayey and sandy soil. (10 marks)

10) What are the properties yielded by the Marshall stability test (use a diagram to illustrate the measurements)? Describe the primary difference between the Marshall stability and Hveem stability in terms of reliability of predicting field performance of asphalt concrete? (10 marks)

11) Given the three aggregate sources available to you in the table below (aggregate A, B, and C), determine a grain size blend (show all calculations) that will meet the SHRP specified aggregate gradation. (15 marks).

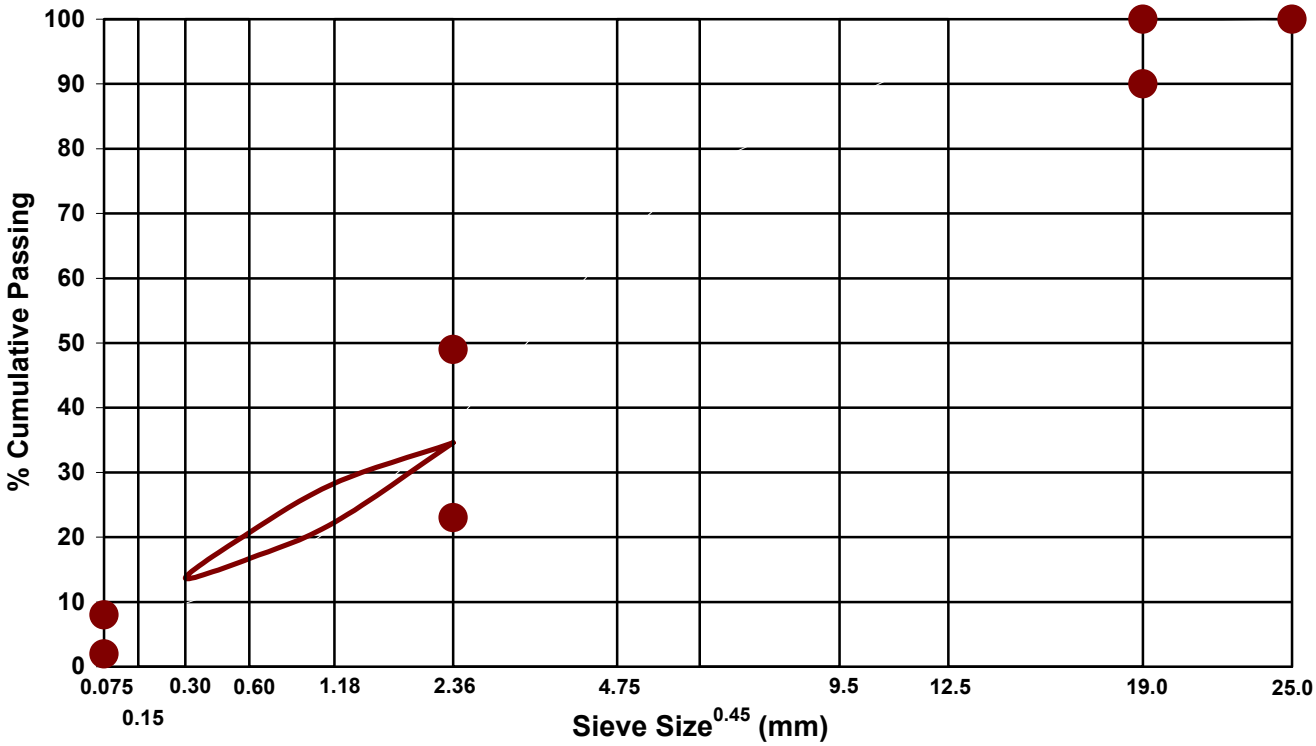
   a) Sketch the raw aggregate stockpile gradations and the blend gradation you determine on the attached SHRP Superpave™ plot.

   b) Were you able to meet the Superpave™ grain size specifications with the three source aggregates? If not, what are your recommendations?

   c) What is the nominal maximum size of the mix specified in the plot?

12) You have been hired to construct a mine haul road in Indonesia. You are to construct the haul road in an area where no asphalt concrete pavement has ever been built. You will have to quarry your hot mix aggregate from the insitu bedrock comprised of sedimentary, intrusive and extrusive igneous, and metamorphic deposits. Describe the evaluation criterion and methodology you would specify in order to evaluate the performance related properties of the alternative aggregate sources for hot mix asphalt concrete. (10 marks).

Seive Size	**Percent Passing**		
	Aggregate A	**Aggregate B**	**Aggregate C**
25mm	100	100	100
19mm	98	100	100
9.5mm	51	100	100
4.75mm	29	83	98
2.36mm	17	52	69
0.600mm	6	32	40
0.300mm	2	14	11
0.075mm	1	8	3



13 Identify the type of distress(s) in the photo, discuss the mechanism of each distress, and the recommended treatment for each distress. (10 marks)

a) Distress(s) types:

b) Mechanism causing the distress(s):

c) Recommended treatments: